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WELUT - 02 PROJECT
REPORT 2200
LOGICAL CAPABILITIES OF THE GIS

BY

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I. INTRODUCTION

A. Goal of the Project

This project is defined and sponsored by the Western Energy and Land Use Team (WELUT) to promote more effective consideration of fish and wildlife resources in the numerous state and federal decisions concerning western land, energy, mineral, and water resources.

The goal of this two year project is to develop an operational capability within the U.S. Fish and Wildlife Service (FWS) to accept, store, manipulate, and output spatially related data for use in a variety of FWS programs. This includes not only the data that has been and will continue to be collected by the FWS, but also includes data available in computerized and non-computerized data files of other federal and state natural resource management agencies. This goal is to be achieved with minimal development of new computer software and minimal hardware requirements. The project will start on a prototype basis within selected test case areas and will broaden to other applications.

The primary operational level users of this system in its developmental stages are in the Billings Area Office (BAO) of the U.S. Fish and Wildlife Service. The biologists in this office are faced with the weekly task of assessing the wildlife resource impacts of various land use changes. This project will attempt to develop simple, useable, practical tools for operational use at the regional and area office level.

This report culminates the first of seven project tasks. Other technical reports will be produced as the system development proceeds.

B. Scope of this Report

This report will outline the wide variety of technical capabilities of the WELUT - 02 Geographic Information System (GIS) which will be produced by October 1978 under contract number 14-16-0008-2155. Four distinct results should arise from this report:

1.) This paper effectively "freezes the design" of all GIS capabilities so that WELUT managers will know, in detail, exactly what they will, and will not get from the GIS.

2.) This paper serves as an applications software design requirement for those commands not yet programmed.

3.) This paper will give field users and research biologists a complete look at the power and flexibility of the GIS capabilities as it will be delivered in October 1978.

4.) This paper allows FWS researchers and users to comment both on detailed GIS capabilities and on the method of their documentation. These capabilities will be summarized in a similar manner in the GIS Users Manual.

II. CAPABILITIES OF THE GIS (AS OF OCTOBER 1978)

A. Summary List of the GIS Capabilities/Commands

The following set of GIS capabilities are being developed as part of the Second Year FRMS Work Plan. The summarized table that follows gives the command name and a very brief description of its capabilities. For full descriptions of command capabilities, see Sections II-B-1 through II-B-8 which give significantly more detail for each command.

COMMAND NAME	SUMMARIZED DESCRIPTION
GENERAL COMMANDS	
1. COST	Produces costs, CPU time, and resources used within a GIS run.
2. FINISH	Terminates a GIS run.
3. HELP	Produces summary lists of all available GIS commands or detailed explanation of each individual command.
4. NEWS	Produces narrative information on recent changes to the GIS.
INPUT AND EDIT COMMANDS	
5. DIGITIZE	Allows the operator to digitize points, lines, or arcs from a map using the ALTEK table and the Data General Eclipse.
6. EDIT	Allows the operator to edit point, line, arc, or polygon coordinates or descriptors. Additions, deletions, or modifications of the above are possible using the Data General Eclipse.
7. DISPLAY	Displays a digitized map on the Tektronix CRT or on the Versatek printer/plotter.
8. DUMP	Produces a systems dump of the entire map data file including coordinates and map descriptors. (Exactly the same as the DBMS command.)
9. POST EDIT	This command performs final editing of points, lines, arcs, or polygons; checks topology of arc files; and produces a clean file ready for input into the DBMS.
DATA BASE MANAGEMENT SYSTEM (DBMS) COMMANDS	
10. LIST	Allows the user to browse at either the file level, the map category level, or the map subject level for any digitized map in the DBMS.
11. ACTIVE	Produces a printout on the CRT displaying all activated polygon, cellular or textual data sets.
12. STATUS	Produces summary statistics on the size and complexity (number of coordinate pairs) of any map in the DBMS or any active map data set.
13. SAVE	Stores an active map data set in a user work file for later use.

COMMAND NAME	SUMMARIZED DESCRIPTION
14. FREE	Selectively deactivates activated map data sets.
15. DUMP	Selectively lists the entire contents of a map file including coordinates and map descriptors on the line printer.
DISPLAY COMMANDS	
16. SHADE	Plots on the CRT and shades with differential cross-hatching, any active polygon map.
17. PLOT	Displays on the CRT selected points, lines, or polygons in a controlled manner.
18. SYMBOL	Plots on the CRT any one of twenty-three possible symbols (circles, boxes, etc.) around any point in a map file.
19. LEGEND	Generates a full map legend including scales, representative fraction, north arrow, title, subject, etc. for any previously plotted map.
20. CONTOUR	Generates a contour map from a grid surface.
21. THREE-D	Produces a three dimensional plot of any 2-D matrix map using cell attributes as the Z value.
22. ERASE	Erases the CRT.
23. WRITE	Writes a polygon line or cell map to a peripheral device including line printer, Calcomp plotter, disc, or tape.
24. WINDOW	Sets the CRT virtual viewing area to correspond to a particular area on the earth's surface at a given scale. Corner points of the window are specified using UTM coordinates.
25. RESET	Sets the virtual viewing window back to the original scale (as it was before a BLOWUP command was issued).
26. BLOWUP	Enlarges or magnifies a portion of the virtual viewing window based on user specifications.
27. LINE	Allows for up to eighteen line symbologies to be used on a map for display purposes (e.g. _ _ _,---------, ___,etc.).
MEASUREMENT COMMANDS	
28. LENGTH	Calculates and prints out the length (in meters and in miles) of all lines and the perimeters of all polygons of a given map.

COMMAND NAME	SUMMARIZED DESCRIPTION
29. DISTANCE	Measures the distance, in meters, between any two points on a CRT screen either along a straight line or along a sinuous line (such as a highway or vegetation edge).
30. AREA	Calculates and prints out the area, in hectares and in acres, of all unique polygon subjects in an active map (islands are excluded).
STATISTICAL COMMANDS	
31. FREQUENCY	Calculates and prints out the frequency of each unique subject in an active map.
32. HISTOGRAM	Produces a labeled bar chart of either a) the frequency of occurrence of polygon subjects, b) the length of line types by subject, or c) the area of polygon types by subject.
33. CROSSTAB	Produces a standard bivariate cross tabulation of the contents of any two cell maps.
34. REGRESSION	Performs a multiple regression on a set of cell maps.
35. DESCRIBE	Calculates and prints out the mean, variance, standard deviation, range, minimum and maximum values of specific area, length, or frequency attributes of any given map.
36. ANOVA	Establishes a one way analysis of variance of cell data between two cellular maps.
37. GRAPH	Produces a user specified and labeled chart of map characteristics.
SPATIAL RETRIEVAL COMMANDS	
38. SELECT	Activates either all or a specific subset of any polygon, arc, or cell map data set.
39. SIZE	Retrieves those polygons or lines from the map file which satisfy the minimum and maximum size requirements.
40. PROXIMITY	Selects all polygons, lines, or points from an active map which are within a user specified distance (X) of a given point, line or polygon set.
41. CONTIGUITY	Finds all polygons of subject type A which are adjacent to polygons of subject type B.

COMMAND NAME	SUMMARIZED DESCRIPTION
42. EDGE	Finds all occurrences where polygon subject type A borders polygon subject type B. The common lineal border or edge is saved as a new map.
43. STUDY AREA	Allows the user to splice together several map sets of the same subject covering different geographical areas (i.e. several county soil maps into a regional soil map).
ANALYSIS COMMANDS	
44. OVERLAY	Superimpose an infinite number of active polygon maps to produce a new map that shows all possible intersections or unions between input polygons.
45. POLYCELL	Converts an activated point, line, or polygon map to an active cellular map at user specified cell size.
46. CELLPOLY	Converts an active cell map back to an active polygon map with optional smoothing.
47. VIEWSHED	Allows the calculation of all areas seen from a given point and vice versa.
48. BUFFER	Draws and optionally stores a buffer zone of user specified radius around any active map containing points, lines, or polygons.
49. COMPOSITE-ARITHMETIC	Allows for mathematical compositing of up to ten cell maps. A resulting cell map is produced.
50. COMPOSITE-LOGICAL	Allows for BOOLEAN logical combinations of an up to ten cell maps. A resulting cell map is produced and stored.
51. SLOPE	Allows the user to transform a cell matrix elevation map into relative slopes with user determined intervals.
52. ASPECT	Allows the user to transform a cell matrix elevation map into relative aspects (N,NE,E,SE,etc.).
53. GRID	Performs a point to grid interpolation as required for viewshed, contouring, or three dimensional analysis.
54. TESTGRID	Superimpose a user specified grid on any polygon map, Primarily for use in determining a good cell size for polygon to cell (POLYCELL) conversion.
55. QUERY	Identifies the characteristics of any point, line or polygon on the CRT by touching the location with the cross hairs.

II.

B. Detailed Command Format Sheets

The following sheets explain each of the fifty-five (55) GIS commands in terms of input required, parameter options, and output produced.

In all cases where there are parameters to a command, the sophisticated user can type in the full parameter set for that interaction, or the novice user can omit all parameters and the system will prompt for each parameter.

Several of the commands are quite difficult to explain in an isolated manner. The best method for learning the commands is to participate in the FRMS sponsored GIS training program which utilizes each of these commands in a problem setting with actual "hands on" use of the system.

II.

B.

1. General Capabilities/Commands

This set of commands is not specific to any of the other GIS subsystems. These commands provide overall user assistance in starting or finishing a GIS run, obtaining the cost of the run, or other GIS "management functions".

I. SUBSYSTEM GENERAL

II. COST

III. NARRATIVE SUMMARY OF CAPABILITIES

This command provides information on the cost, execution time, and the number of ten character words the GIS has processed at any point in a GIS session.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

COST

PARAMETERS

None

V. EXAMPLE

?COST

Output

```
Total Time      =   .15 seconds
Total Words     =  5.00
Total Job Cost  = $ .02
```

#2
FINISH
COMMAND SUMMARY

I. SUBSYSTEM GENERAL

II. FINISH

III. NARRATIVE SUMMARY OF CAPABILITIES

This command will terminate the MOSS program. This command returns the user to the computer operating system.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

FINISH

PARAMETERS

None

V. EXAMPLE

FINISH

This command terminates the session, prints out cost of session, resources used and returns to the operating system.

I. SUBSYSTEM GENERAL

II. HELP

III. NARRATIVE SUMMARY OF CAPABILITIES

This command provides either 1) a listing of the GIS commands or 2) a description of the capabilities and options of a specific command.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

There are two variations of the HELP command:

HELP (with no parameters)

HELP CN

PARAMETERS

CN = The name of another GIS command (e.g. SELECT,PLOT,WINDOW,etc.)

V. EXAMPLE

?HELP

This command would produce a listing and brief description of all the GIS commands optional to date.

?HELP WINDOW

This command would produce a description of the capabilities and options of the WINDOW command.

#4
NEWS
COMMAND SUMMARY

I. SUBSYSTEM GENERAL

II. NEWS

III. NARRATIVE SUMMARY OF CAPABILITIES

This command informs the user of any new changes in the GIS system. Changes may include new commands, new capabilities or new data bases available to the user.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

NEWS

PARAMETERS

None

V. EXAMPLE

NEWS

II.

B.

2. Data Input And Edit Capabilities/Commands

This set of commands is used for the digitizing and editing of maps using the ALTEK digitizing table and the Data General Eclipse Mini Computer. All commands will be written to be compatible with this hardware equipment, with the TEKTRONIX/CRT, and with the TEKTRONIX digitizing tablet.

These commands will be performed by a skilled and highly trained digitizer operator. The general user population would not be involved with these commands to any great extent.

#5
DIGITIZE
COMMAND SUMMARY

I. SUBSYSTEM INPUT AND EDIT

II. DIGITIZE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to digitize points, lines or arcs from a map using the ALTEK table and the Data General Eclipse. During initialization, the user will be prompted for the following:

1.) Name
2.) Title of map
3.) Source of map
4.) Scale of map
5.) Point or stream mode
6.) Time, grid or delta sample
7.) Map projection of input map
8.) OUTPUT digitized map file name

During digitization, the user may enter feature codes and descriptions for each item digitized. As data are being digitized, they will be displayed on a CRT.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

DIGITIZE FILENAME

PARAMETERS

FILENAME = Name of the data set which will contain the resulting digitized information.

V. EXAMPLE

DIGITIZE

#6
EDIT
COMMAND SUMMARY

I. SUBSYSTEM INPUT AND EDIT

II. EDIT

III. NARRATIVE SUMMARY OF CAPABILITIES

This command edits a digitized map file. The operator can edit point, line, arc, and polygon descriptors. He can add and delete points, lines, and polygons. He can modify points, lines, and polygons.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

EDIT FILENAME

PARAMETERS

FILENAME = Name of digitized data file to be edited

V. EXAMPLE

EDIT ANTELOPE

#7
DISPLAY
COMMAND SUMMARY

I. SUBSYSTEM INPUT AND EDIT

II. DISPLAY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command displays a digitized map on the CRT or on the Versatek Printer/Plotter for test plotting purposes.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

DISPLAY FILE NAME, DEVICE

PARAMETERS

FILE NAME = Name of Digitized Map File
DEVICE = CODE for Output Device
CRT = Cathode Ray Tube VTK = Versatek Printer/Plotter

V. EXAMPLE

DISPLAY ANTELOPE

This command displays the digitized map ANTELOPE on the CRT or on the Versatec Printer/Plotter for test plotting purposes.

#8
DUMP
COMMAND SUMMARY

I. SUBSYSTEM INPUT AND EDIT

II. DUMP

SEE COMMAND #15 FOR DETAILS

I. SUBSYSTEM INPUT AND EDIT

II. POSTEDIT

III. NARRATIVE SUMMARY OF CAPABILITIES

This command performs the following batch mode edits on a previously edited and digitized map file.

1) Delete duplicate and extraneous points
2) Delete points, lines, arcs, and polygons with the same ID number
3) Make a final check on the topology of arc files and if the topology checks, perform arc to polygon procedure if requested
4) Convert from table coordinates to data base coordinates(UTM, LAT/LONG)
5) Calculate areas and centroids of polygons, line lengths, and minimum bounding rectangles for insertion into file reader
6) Format data for insertion into data base

The output from this procedure is a clean file formatted for input into the data base.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

POSTEDIT FILEIN FILEOUT

PARAMETERS

FILEIN = Digitized map input file name
FILEOUT = Clean, formatted map output name

V. EXAMPLE

POSTEDIT ANTELOP, WANTELOP

This command reads in the ANTELOP file, cleans and edits this file and produces a new cleaned file called WANTELOP.

B.

3. DBMS Capabilities/Commands (Data Base Management System)

In order to better understand the DBMS commands it is imperative to understand a few key words that will be used in this section. The key words and their respective definitions, as used in this section, are the following:

Map Name	-A map name is the name of a map dat set stored in the master map file. An example map name would be ROADS which is, in effect, a digitized road map stored in the computer.
Category	-A category is a major heading given to a set of data in a map file. For example, one category of data of a map data set called ROADS could be INTERSTATES and another category could be STATE HIGHWAYS.
Subject	-Within a map data set, it is often useful to be able to divide categories into more units. For example, under the category of INTERSTATES, subjects may be I25, I70, etc.
Master Data Base	-All digitized maps within a study area reside on the Master Data Base. This Master Data Base thus contains all available data for a given study area. However, not all of this data will necessarily be used for any given problem. Thus, the user has the responsibility to "activate" the data from the Master Data Base which he needs; all other data remains "inactive" in the Master Data Base.
Active Map	-Before any map data set or portion of a map data set can be used by the user of the GIS, it must first be activated from the Master Data Base. To activate a data set, the SELECT command is used to select either an entire map data set (an entire road map), a category (INTERSTATES), or a subject (I25). After data is selected from the Master Data Base, it is called ACTIVE.
Workfile	-The term Workfile is given to a set of ACTIVE map data that the user wishes to save for future use. For example, once a user selects INTERSTATES from the ROADS map data set, he can store this new map (INTERSTATES) as workfile. Workfiles help eliminate the time required of the user to recreate data sets he will be using repetitively over a period of several days or weeks.

I. SUBSYSTEM DBMS

II. LIST

III. NARRATIVE SUMMARY OF CAPABILITIES

This command is used to list the following:

1) The files (maps) in the GIS master data base
2) The subjects or categories (i.e. the legend) of a specific file (map) in the GIS Master Data Base.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

There are three variations to the LIST command:

LIST FILES

LIST MAP NAME,CATEGORIES

LIST WORKFILE SUBJECTS

PARAMETERS

MAP NAME	=	The name of a map data set stored in the master map file (e.g. ROADS)
CATEGORY	=	A major grouping of SUBJECTS contained in the master map data set (MAPID) (e.g. Interstates)
SUBJECT	=	A specific grouping of items with common characteristics (e.g. Interstate 25)
WORKFILE	=	The name of a map data set created by the user using the SELECT and SAVE commands.

V. EXAMPLE

?LIST FILES

This example would produce a list of all the files or maps in the GIS master data base.

?LIST WCOUNTY SUBJECTS

This example would produce a listing of all the subjects in the file named WCOUNTY.

I. SUBSYSTEM DBMS

II. ACTIVE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command produces a printout showing all the map data sets or subsets of a map data set that have been activiated by a previous GIS command (e.g. SELECT, SIZE, POLYCELL,etc.). Specifically, the information given on the printout includes the following:

1. the unique identifying number for that active data set
2. the number of items (entries) in that active map data set
3. the subject selected (if blank, the entire map data set was selected)
4. the name of the file in the master data base from which the active map data set was selected.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

ACTIVE

PARAMETERS

None

V. EXAMPLE

?ACTIVE

This example will produce a listing of all the maps in the active data set file.

#12
STATUS
COMMAND SUMMARY

I. SUBSYSTEM DBMS

II. STATUS

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to obtain figures concerning the number of items and coordinate pairs of a specified data base, file, or active file. This information is often useful to decipher the size or complexity of a map file and thus the relative cost of processing that map file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

STATUS MAPID
STATUS DATA BASE
STATUS MAPNAME

PARAMETERS

MAPID = Active Map ID Number
DATA BASE= An entire map data base
MAPNAME = Provide information on an individual map in the data base

V. EXAMPLE

STATUS 2

This command will print out the number of items and coordinate pairs in Active Map ID 2.

#13
SAVE
COMMAND SUMMARY

I. SUBSYSTEM DBMS

II. SAVE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command saves an active data set as a user named WORKFILE. After the SAVE has been issued, this workfile can be accessed later in another GIS run the next day or the next week.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

SAVE MAPID

PARAMETERS

MAPID = Active map data set to save

V. EXAMPLE

SAVE 7

This command saves active data set 7 as part of a user workfile.

I. SUBSYSTEM DBMS

II. FREE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to selectively deactivate active map data sets that have been selected using the SELECT command.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

There are two options to the FREE command:

FREE MAPID

or

FREE ALL

PARAMETERS

MAP ID = Active Map ID Number

V. EXAMPLE

FREE 2

This command deactivates Active Data Set 2.

FREE ALL

This command deactivates all active data sets.

#15
DUMP
COMMAND SUMMARY

I. SUBSYSTEM DBMS

II. DUMP

III. NARRATIVE SUMMARY OF CAPABILITIES

This command dumps a specified GIS map file to a local file (TAPE 4) formatted for output on a line printer. This is primarily another mode of checking the contents and integrity of a MOSS data file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

DUMP FILE NAME

PARAMETERS

FILE NAME = Name of file to be dumped

V. EXAMPLE

DUMP WANTELOP

This command dumps MOSS file WANTELOP to local file TAPE 4 which can then be disposed to a line printer.

4. Display Capabilities/Commands

These commands allow for the display of point, line or polygon information on peripheral display devices. The primary peripheral display device used is the TEKTRONIX 4010 or the 4014 Cathode Ray Tube which can be attached to either the CDC-CYBER or to the Data General Eclipse. Other peripheral devices to which the GIS will write information include the following:

1.) The VERSATEK Printer/Plotter
2.) The Magnetic Tape
3.) The CALCOMP Plotter
4.) The Line Printer
5.) Disk

#16
SHADE
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. SHADE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command plots and shades with differential crosshatching any polygonal map stored in the active data set file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

SHADE MAPID1,MAPID2,...MAPIDN

PARAMETERS

$MAPID_i$ = The ID Number of an Active Map Data Set

V. EXAMPLE

?SHADE 1,2

This example would plot and shade active map data sets number 1 and number 2.

I. SUBSYSTEM DISPLAY

II. PLOT

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to display data that have been selected using the SELECT command. The two variations of the PLOT command are the following:

PLOT
PLOT 1,2

PLOT displays those points, lines, or polygons activated by the most recent SELECT. PLOT 1,2 lets the user plot unique active data set numbers 1 and 2.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

PLOT
PLOT MAPID1,MAPID2,...MAPIDN

PARAMETERS

$MAPID_i$ = Active Map ID Number to be plotted
BLANK = Default to the last MAPID selected

V. EXAMPLE

PLOT

This command displays the most recent SELECT.

PLOT 2

This command displays Activated Data Set 2.

#18
SYMBOL
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. SYMBOL

III. NARRATIVE SUMMARY OF CAPABILITIES

This command plots one of twenty three symbols around any point data (e.g. Ferret sightings) contained in the active data set file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

SYMBOL MAPID,USER,S1,S2,...S_N(opt)

PARAMETERS

MAPID = Active Data Set ID Numbers
USER = No - Default symbol assignment
Yes- User specified symbols
S1 = Symbol Type

V. EXAMPLE

Enter Command
?SYMBOL 1,14 (where symbol 14 is a circle)

This example would draw a circle around all points in active map data set 1. Legend information is stored for later use if the LEGEND command is used.

#19
LEGEND
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. LEGEND

III. NARRATIVE SUMMARY OF CAPABILITIES

This command generates a full map legend for a user specified active data set. The legend will include the following: 1.) scale, 2.) representative fraction, 3.) north arrow, 4.) title, and 5.) subject legend and assigned labels for displayed map.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

LEGEND MAPID,NORTH,SCALE,TITLE,RF,SLEGEND

PARAMETERS

MAPID	=	Active Map ID Number
NORTH	=	NDRTHARROW? (YES or NO) default = YES
SCALE	=	SCALE? (YES or NO) default = YES
TITLE	=	TITLE? (YES or NO) default = YES
RF	=	Representative fraction? (YES or NO) default = YES
SLEGEND	=	Subject legend? (YES or NO) default = YES

V. EXAMPLE

LEGEND 2,YES,YES,NO,NO,YES

This command develops a legend for active data set 2. The legend will have a north arrow, scale, and subject legend. There will be no RF or title.

#20
CONTOUR
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. CONTOUR

III. NARRATIVE SUMMARY OF CAPABILITIES

This command generates contour maps given a grid representing the surface to be contoured.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

CONTOUR,MAPID, SAVFILE,TYPE,NINTS,SMOOTH

PARAMETERS

MAPID = Active Grid Data Set to be contoured
SAVFILE = Save Result as New Map? ("YES" or "NO")
TYPE = Program specified contour or variable contours
Two options are available:
1) DEFAULT = The program calculates the contour intervals
2) USER = User wants to specify his own contour intervals. If "user", interval information is prompted for.
NINTS = Number of contour intervals
SMOOTH = Smooth matrix before contouring? ("YES"or"NO")

V. EXAMPLE

CONTOUR,4,YES,USER,10,NO

Contour Active Data Set 4. Save the results. User specified intervals. Ten intervals. Do not smooth the matrix.

#21
Three-D
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. THREE-D

III. NARRATIVE SUMMARY OF CAPABILITIES

This command generates a three-dimensional diagram from a set of grid data. The user can specify orientation and surface representation. Hidden lines are removed.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

THREE-D MAPID,METHOD,HEIGHT,XROT,YROT

PARAMETERS

MAPID	=	Active map data set number (gridded data)
METHOD	=	1 = grid in X
		2 = grid in Y
		3 = grid in both directions
		4 = grid diagonal
		5 = histogram type
HEIGHT	=	Vertical exageration
XROT	=	Rotation in X
YROT	=	Rotation in Y

V. EXAMPLE

THREE-D 1,3,2.0,25.0,35.0

Three dimensional block diagram of active map data set 1. Gridding is in both directions, verticle exageration is two times. The diagram is rotated 25° in X and 35° in Y.

#22
ERASE
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. ERASE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to erase the CRT viewing screen.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

ERASE

PARAMETERS

None

V. EXAMPLE

ERASE

This command erases the CRT viewing screen.

#23
WRITE
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. WRITE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command generates files for output to devices and data bases external to MOSS. This would allow for transferal of data or generation of line printer maps or production of plotter maps.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

WRITE MAPID,DEVICE

PARAMETERS

MAPID = Active Map Data Set Number
DEVICE = PRINTER (cell data)
PLOTTER
PRNTR/PLTR
DISK
TAPE
SCANNER

V. EXAMPLE

WRITE 3,PRINTER

Write active map data set to the line printer (cell data only).

#24
WINDOW
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. WINDOW

III. NARRATIVE SUMMARY OF CAPABILITIES

This command lets the user set a virtual window on the data set. The window is defined by the corner points of a UTM rectangle. Any active data falling within this window can be displayed using the PLOT command.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

WINDOW

PARAMETERS

None

V. EXAMPLE

```
WINDOW
X-ORIGIN  =   200000
Y-ORIGIN  =  4500000
X-LENGTH  =   600000
Y-LENGTH  =   490000
```

This command sets the viewing window for the state of Wyoming.

#25
RESET
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. RESET

III. NARRATIVE SUMMARY OF CAPABILITIES

This command is used to set the virtual window back to what it was before a BLOWUP command was issued. RESET is only used after a portion of the virtual window has been enlarged with the BLOWUP command.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

RESET

PARAMETERS

None

V. EXAMPLE

?RESET

This example would erase the screen and set the virtual window back to what it was before the BLOWUP command was issued.

#26
BLOWUP
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. BLOWUP

III. NARRATIVE SUMMARY OF CAPABILITIES

This command is used to enlarge or magnify a portion of the screen that is specified by the user.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

BLOWUP

PARAMETERS

None. The user is prompted to specify with the cross hairs a rectangle of the area to be magnified.

V. EXAMPLE

?BLOWUP
Point to corners of viewing rectangle

When the crosshairs on the graphics display terminal appear, move them to one corner of the rectangular area to be enlarged. Wait a few seconds, then strike any character on the terminal keyboard and then strike the RETURN key. The crosshairs will momentarily disappear. When they return, move the crosshairs to the opposite (i.e. diagonal) corner of the desired rectangle. Again strike any character and then strike RETURN. The GIS will respond by drawing in the boundaries of the rectangle. After the screen has been erased (ERASE), an enlarged map of the area within the rectangle can then be plotted (PLOT).

#27
LINE
COMMAND SUMMARY

I. SUBSYSTEM DISPLAY

II. LINE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command produces maps of line (or polygon) data where each map overlay (subject) is represented by a unique line symbology.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

LINE MAPID1,...MAPIDN ASSIGN S1,S2,...SN

PARAMETERS

MAPID	=	Active map data sets
ASSIGN	=	No - if Moss assigns symbology Yes - if user assigns symbology
S	=	User symbol assignments if ASSIGN=YES (SN=MAPIDN)

V. EXAMPLE

LINE 1,6,3 YES 2,11,5

A symbolized line map of active map data sets 1,6,and 3. User assigned symbology types 2,11, and 5 (symbology types will be displayed by program if requested).

5. Measurement Capabilities/Commands

The three Measurement commands provide basic information related to a MAPID. These three basic measurements can be graphically displayed using the HISTOGRAM command (#32) or can be quantitatively analyzed using the DESCRIBE command (#35).

Thus, the Measurement commands are three basic building blocks for more sophisticated forms of spatial analysis.

#28
LENGTH
COMMAND SUMMARY

I. SUBSYSTEM MEASUREMENT

II. LENGTH

III. NARRATIVE SUMMARY OF CAPABILITIES

This command calculates and prints out the length, in meters and in miles, of all lines and the perimeter of all polygons in a given active map.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

LENGTH MAPID

PARAMETERS

MAPID = Active Map ID Number

V. EXAMPLE

LENGTH 5

This command calculates and prints out the length of all lines and the perimeter of all polygons in Active Map 5. A printout, in the following format, is produced.

UNIQUE SUBJECT	LENGTH IN KILOMETERS	LENGTH IN MILES	PERCENTAGE OF LENGTH
Secondary Highways	1,210	752	59.2
Divided Highways	158	98	7.7
Primary Highways	677	421	33.1
TOTAL	2,045	1,271	100.0

#29
DISTANCE
COMMAND SUMMARY

I. SUBSYSTEM MEASUREMENT

II. DISTANCE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to measure the distance between two points on the screen as indicated with the CRT cursor. The user simply points to two different points on the screen and the distance between the two points is calculated either along a straight line or along a sinuous line (such as highway or vegetation edge etc.). The length is printed out on the screen.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

DISTANCE,TYPE

PARAMETERS

TYPE = AIRLINE - Straight distance between two points
= LINE - Distance on a line between two points. The end points of the sinuous line are specified by the cross hairs.

V. EXAMPLE

DISTANCE AIRLINE

This command measures the distance, in miles, between two points indicated by the user with the cursor. A straight line (as the crow flies) distance calculation is used. Length equals 6.035 kilometers (3.75 miles).

#30
AREA
COMMAND SUMMARY

I. SUBSYSTEM MEASUREMENT

II. AREA

III. NARRATIVE SUMMARY OF CAPABILITIES

This command calculates and prints out the area (in acres and in hectares) of all unique polygon subjects in an active map. NOTE: Polygon areas do not include the areas of enclosed "island" polygons.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

AREA MAPID

PARAMETERS

MAP ID = Active Map ID Number

V. EXAMPLE

AREA 4

This command calculates and prints out the area of all unique polygon subjects in Active Map 4. A printout, in the following format, is produced.

UNIQUE SUBJECT	AREA IN HECTARES	AREA IN ACRES	PERCENTAGE OF AREA
WATER	518	2	2.9
PINE	11,655	45	66.2
FIR	5,439	21	31.9
TOTAL	17,612	68	100.0

6. Statistical Capabilities/Commands

This set of seven Statistical commands produce more sophisticated types of spatial analysis (Analysis of Variance, Regression, etc.) of mapped data. Other Statistical commands produce tabular graphical output of spatial characteristics of a map (e.g. HISTOGRAM, CROSSTAB, GRAPH, FREQUENCY).

These commands should be used only after the basic maps have been understood thoroughly.

I. SUBSYSTEM STATISTICAL

II. FREQUENCY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command calculates and prints out the frequency of each unique subject in an active map.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

FREQ MAPID

PARAMETER

MAPID = Active Map ID Number

V. EXAMPLE

FREQ 3

This produces a frequency count of the number of items of each unique subject in Active Map ID 3. The following printout results:

UNIQUE SUBJECT	NUMBER OF OCCURRENCES	PERCENTAGE	CUMULATIVE %
Water	8	21	21
Ponderosa Pine	18	47	68
Douglas Fir	12	32	100
TOTAL	38	100	-

#32
HISTOGRAM
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. HISTOGRAM

III. NARRATIVE SUMMARY OF CAPABILITIES

This command produces a labeled bar chart or histogram of either a) the frequency of occurrence of polygon subjects, b) the length of line types by subject, or c) the area of polygon types by subject. The bar chart will represent percentages rather than absolute values.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

HISTOGRAM TYPE,MAPID

PARAMETERS

TYPE = The type of data desired to be represented in the histogram

F = Frequency of occurrence of polygon types by subject
L = Length of lines or perimeter of polygons by subject
A = Area of polygons by subject

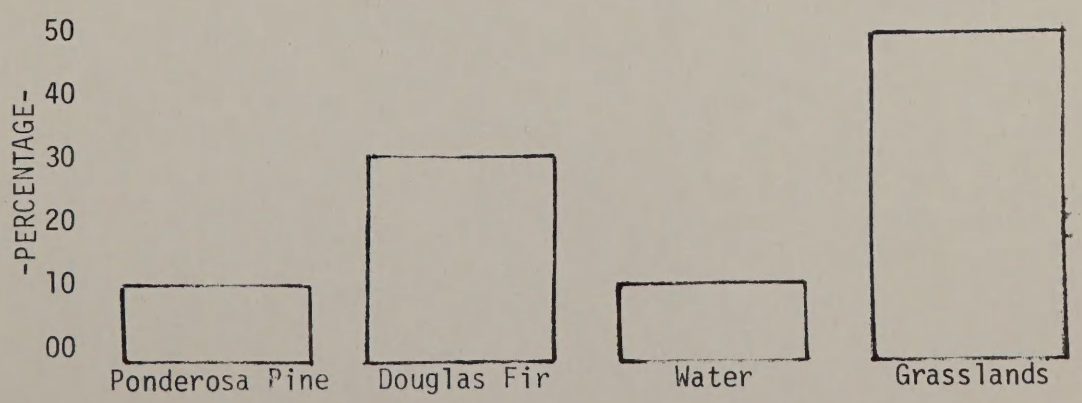
MAP ID = The active map ID number to by evaluated for frequence of occurrence, length, or area.

V. EXAMPLE

HISTOGRAM

This command is to produce a histogram representing the percentage of area within each unique subject in Active Map ID 3. The output would look like the following.

HISTOGRAM OF AREA OF VEGETAION



#33
CROSSTAB
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. CROSSTAB

III. NARRATIVE SUMMARY OF CAPABILITIES

This command produces a bivariate cross tabulation.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

CROSSTAB MAPID1,MAPID2

PARAMETERS

MAPID1
MAPID2= Active cell data sets to crosstab

V. EXAMPLE

CROSSTAB 6,3

This command cross tabulates active cell data set 6 and 3.

#34
REGRESSION
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. REGRESSION

III. NARRATIVE SUMMARY OF CAPABILITIES

This command will perform multiple regression on a set of cell files. Output includes the following: 1.) R, 2.) R^2, 3.) ANOVA on R, 4.) Confidence limits, 5.) Beta weights, 6.) A intercept, 7.) R criterion, 8.) Determinant of inverted correlation matrix, 9.) Beta square, and 10.) Beta R.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

REGRESSION DEP,IND1,IND2,IND3,...IND_N

PARAMETERS

DEP = Active data set number of dependent variable
IND = Active data set number of independent variable

V. EXAMPLE

REGRESSION 10 1,6,3,4

This command performs a multiple regression using the cell value in active data set 10 as the dependent variable and the cell value in active data sets 1,6,3,4 as the independent variables.

#35
DESCRIBE
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. DESCRIBE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command calculates and prints out the mean, variance, standard deviation, range, and the minimum and maximum values of specific area length or frequency attributes of data subjects in a given active polygon, line or point map ID.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

DESCRIBE MAPID,TYPE

PARAMETERS

MAPID = Active Map ID Number
TYPE = Actual data set attribute which will be described statistically

AREA = Describe statistics of area by subject
LENGTH = Describe statistics of length by subject
FREQUENCY = Describe statistics of frequency by subject

V. EXAMPLE

DESCRIBE 3,AREAS

This command will print out descriptive statistics for the area active map 3 by subject.

#36
ANOVA
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. ANOVA

III. NARRATIVE SUMMARY OF CAPABILITIES

This command does one way analysis of variance of cell data. Output includes the following: 1.) totals, 2.) means, 3.) grand mean, 4.) ANOVA table, and 5.) F statistics.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

ANOVA MAPID1,MAPID2

PARAMETERS

MAPID1 = Variable 1
MAPID2 = Variable 2

V. EXAMPLE

ANOVA 6,3

This command analyzes the variance using active data sets six and three.

#37
GRAPH
COMMAND SUMMARY

I. SUBSYSTEM STATISTICAL

II. GRAPH

III. NARRATIVE SUMMARY OF CAPABILITIES

This command displays, on a CRT, two variable line and bar graphs. The axis will contain user specified labels.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

GRAPH MAPID1,MAPID2,TYPE

PARAMETERS

MAPID1	=	X axis variable
MAPID2	=	Y axis variable
TYPE	=	LINE if line graph or BAR if bar graph

V. EXAMPLE

GRAPH 3,1,BAR

This command displays a bar graph using active map data sets three and one. Default labels are provided.

B.

7. Spatial Retrieval Capabilities/Commands

This set of six powerful Spatial Retrieval commands allow the user to select specific polygons, lines, or points from the Master Data Base. The selection criteria can be either their nominal characteristics (MAP NAME, SUBJECT, etc.) or their spatial characteristics (size, proximity, or contiguity to other polygons). Thus, the user can select only those polygons, points, or lines from the Master Data Base which meet specific criteria. Selected points, lines, or polygons are then activated to the status of an "ACTIVE MAP".

#38
SELECT
COMMAND SUMMARY

I. SUBSYSTEM SPATIAL RETRIEVAL

II. SELECT

III. NARRATIVE SUMMARY OF CAPABILITIES

This command is used to activate either all or a specific subset of a map data set that is stored in the master data base.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

Five options of the SELECT command are available:

1) SELECT MAPNAME, CATEGORY, SEARCH
2) SELECT MAPNAME, SUBJECT, SEARCH
3) SELECT MAPNAME, ITEM, SEARCH
4) SELECT MAPNAME, ALL
5) WORKFILE TYPE NAME

PARAMETERS

MAPNAME	=	The name of a map data set stored in the master map data base (e.g. ROADS)
CATEGORY	=	A major grouping of subjects contained in the master map data set MAPID (e.g. INTERSTATES)
SUBJECT	=	A specific grouping of items with common characteristics (e.g. INTERSTATE 25)
ITEM	=	A specific polygon, point or line segment (e.g. INTERSTATE 25 between DENVER and FORT COLLINS)
ALL	=	Every CATEGORY, SUBJECT, and ITEM in the master map data set MAPID
SEARCH	=	A unique character search string identifying the category(ies), subject(s), or item(s) to be selected
TYPE	=	Cell for cell work file
	=	Polygon for arc and polygon work file
NAME	=	Name ofwork file map to activate

V. EXAMPLE

```
?SELECT WANTELOP SUBJECT
Enter subject search string
?WINTER RANGE/CRITICAL
```

This example would activate all the areas (i.e. polygons) of critical winter range found in the map file WANTELOP.

#39
SIZE
COMMAND SUMMARY

I. SUBSYSTEM SPATIAL RETRIEVAL

II. SIZE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to select line data on the basis of length and polygon data as the basis of area. The SIZE command uses an active map data set as input and produces a new active map data set as output.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

SIZE MAPID,LINE or POLYGON,MIN,MAX

PARAMETERS

MAPID	=	Active Map ID Number
LINE or POLYGON	=	User specifies if he is searching line or polygon data
MIN	=	Minimum line length or polygon size
MAX	=	Maximum line length or polygon size

V. EXAMPLE

SIZE 1,POLYGON,2000,10000

This command selects all polygons within Active Map ID 1 between 2000 and 10000 acres in size. A new active map file is then created.

#40
PROXIMITY
COMMAND SUMMARY

I. SUBSYSTEM SPATIAL RETRIEVAL

II. PROXIMITY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command selects from an active data set all polygons, points or lines which are within a user specified distance (X) from a point specified by the cross hairs.

A second option selects from an active data set all polygons, points, or lines which are within a user specified distance (X) from all occurrences of points, lines or polygons in another active map.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

PROXIMITY MAPID1, MAPID2*, (MAXDIST, MINDIST)

PARAMETERS

MAPID1	=	Active Map ID Number which contian points or polygons of one subject type which is the object of the search
MAPID2	=	Active Map ID Number which contain points, polygons, or lines which is the origin of the search
MAXDIST	=	Maximum distance, in miles, to search from the cross hairs point (option 1) or from any point, line, or polygon in MAPID2.
MINDIST	=	Optional Minimum distance for search

V. EXAMPLE

PROXIMITY 1,2,(5,1)

This example finds and stores all polygons from Active Map 1 which are greater than one mile and less than five miles of the polygons in Active Map 2.

* If this parameter is not specified, the system requests an origin point from the user by using a cross hair.

#41
CONTIGUITY
COMMAND SUMMARY

I. SUBSYSTEM SPATIAL RETRIEVAL

II. CONTIGUITY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command will find all polygons of subject type A from active map ID 1 which are adjacent to (border) polygons of subject type B from active mapID2 (Map 1 and Map 2 were previously created by a subject select). A single output map is produced which contains only the specified contiguous polygons.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

CONTIGUITY MAPID1,MAPID2,MAPOUT

PARAMETERS

MAPID1 = Active polygon map ID Number which contains only polygons with subjects named "SUBJ A"

MAPID2 = Active polygon map ID Number which contains only polygons with subjects named "SUBJ B"

MAPOUT = Name of new active data set polygon map to be produced which contains only those polygons of type (SUBJ A and SUBJ B) which are contiguous

V. EXAMPLE

CONTIGUITY 3, 5, JIM

If Map ID 3, containing Douglas Fir, and Map ID 5, containing water, this command searches for all Douglas Fir polygons in Map ID 3 which touch water polygons in Map ID 5 and store those contiguous water and Douglas Fir polygons in a new active map data set called JIM.

#42
EDGE
COMMAND SUMMARY

I. SUBSYSTEM SPATIAL RETRIEVAL

II. EDGE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command will find all occurrences where polygon subject A from active map #1 borders polygon subject B from active map 2 (map 1 and map 2 were previously created from a common map by a select command). A new line map is produced which contains only those specified boundaries between polygon type 1 and 2.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

EDGE MAPID1,MAPID2,MAPOUT

PARAMETERS

MAP ID 1= Active Map ID Number which contains only polygons of Subject A
MAP ID 2= Active Map ID Number which contains only polygons of Subject B
MAP OUT = Name of new work file line map to be produced

V. EXAMPLE

EDGE 3,4 RIPARIAN

If Map ID 3 contains water and Map ID 4 is Willow, this command searches for occurrences where a water polygon from Map ID 3 touches a willow polygon from Map ID 4. When ever this boundary is found, the line forming this boundary is written to a new line map named RIPARIAN.

I. SUBSYSTEM SPATIAL RETRIEVAL

II. STUDY AREA

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to specify a UTM rectangle of any size or shape. This rectangle is then used as a retrieval envelope on a specified set of active map data sets. Any items falling within this envelope are saved as part of a workfile data set. Any items crossing the envelope border are clipped and saved in the workfile. This command is usually used to combine several master map data sets of the same subject covering different geographical areas.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

STUDYAREA MAPID 1, MAPID 2,...MAPID N, SAVE, INPUT, NAME

PARAMETERS

MAPID = Active map data sets to use
SAVE = Save result as workfile? (YES or NO)
INPUT = Enter studyarea envelope options (KEYBORRD or by CURSOR)
NAME = Name to give new map

V. EXAMPLE

STUDYAREA 1,3,6 YES CURSOR RETA

This command would window and combine active map ID 1 (Campbell County soils map) with active map ID 2 (Sheridan County soils map) with active map ID 3 (Rosebud County soils map) and would save the result as a new regional soils map named RETA. The boundary for the window would be input by the cursor and the results would be saved as a new work file.

8. Analysis Capabilities/Commands

This set of thirteen Analysis commands is the "bread and butter" routines of the GIS. They perform the major part of the spatial manipulation for the GIS.

Using these commands, the user can perform the following manipulations on polygon data:

1.) Polygon overlay (#44)
2.) Polygon to cell conversion (#45)
3.) Buffer zone creation (#48)
4.) Test Grid (#54)
5.) Query for identification (#55)

The user can perform the following manipulations on cell data:

1.) Convert from cell to polygon (#46)
2.) Viewshed analysis (#47)
3.) Composite Arithmetically (#49)
4.) Composite Logically (#50)
5.) Slope Analysis (#51)
6.) Aspect Analysis (#52)

The user can perform the following on point data:

1.) Point to grid interpolation

#44
OVERLAY
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. OVERLAY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command overlays an infinite number of active polygon maps to provide a new active map that shows the intersection between all polygons in the separate maps.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

OVERLAY MAPID1,MAPID2,...MAPIDN,SLIVER,SAVE,NEWMAP

PARAMETERS

$MAPID_i$	=	Active Map ID(s) to overlay
SAVE	=	Yes=Save New Map; No=Do Not Save Map
SLIVER	=	Flag to denote option to remove small erroneous polygons resulting from overlay. Options are: Yes=Remove slivers and No=Leave slivers in
NEWMAP	=	Resulting map name

V. EXAMPLE

OVERLAY 1,2,NO,YES,COMP

This example would overlay Active Map 1 with Active Map 2. Slivers are not removed. The result is saved as a new active map ID called COMP.

I. SUBSYSTEM ANALYSIS

II. POLYCELL

III. NARRATIVE SUMMARY OF CAPABILITIES

POLYCELL converts an active point, line, or polygon map to an active cellular map with the option to specify resulting cell size or to recode one or several polygon subject IDs to a new cell ID. The resulting cell file is not stored in the master data base by this command but is retained in a cell map work file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

POLYCELL MAPID1,CELLSIZ,SAVE,RECODE

PARAMETERS

MAPID1 = ID Number of the active polygon file which will be converted to cells
CELLSIZ = The desired cell size in acres
SAVE = "Yes" or "No" switch to save or not to save the resulting cell file. NOTE: If SAVE = "Yes", a series of further prompted questions are asked to fill in the cell file header user information
RECODE = "Yes" or "No" defining if the polygon subjects are to be recoded before cellularizing. If "Yes" is specified, a series of recoding questions are asked by the system.

V. EXAMPLE

POLYCELL 3,5000,NO,NO

This command converts Active Map File 3 to a cell file of 5000 acre cells and does not store the resulting cell file. No recoding is performed before cellularization.

#46
CELLPOLY
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. CELLPOLY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command converts an active cell file (rows and columns) to an active polygon map data set. Either square or rectangular cells can be converted to polygons with a variable amount of smoothening. This routine performs the opposite function as the POLYCELL rountine.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

CELLPOLY MAPID, POLYFIL, SMOOTH

PARAMETERS

MAP ID = Active Map ID of the input cell map

POLYFIL = Name of new polygon file to be created

SMOOTH = Parameter to allow for variable amount of smoothening of the resulting polygon file.
- 0 = No Smoothening
- 1 = Minor smoothening with a quadratic fit
- 2 = Extensive smoothening with polynomial fit

V. EXAMPLE

POLYCELL 1, VEGPOLY, 0

This command requests that Active Cell Data Set 1 be converted to a polygon data file with no smoothening.

#47
VIEWSHED
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. VIEWSHED

III. NARRATIVE SUMMARY OF CAPABILITIES

Given a matrix of elevations, this command allows the user to point with the cross hairs to a location on the CRT and determine what areas are seen from that point.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

VIEWSHED,MAPID1,MAPID2

PARAMETERS

MAPID1 = Active Cellular Map used for locating observation
MAPID2 = Active Cellular Map of elevation used to compute which cells can be seen from other cells. MAPID1 and MAPID2 must cover the same geographical area.

V. EXAMPLE

VIEWSHED,2,3

This command plots base active cell map data set 2 on which the user points to an observation point with the cursor. A cell map is then plotted indicating all cells seen from that observation point. Active map data set 3 is the elevation map used to compute which cells can be seen from other cells.

#48
BUFFER
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. BUFFER

III. NARRATIVE SUMMARY OF CAPABILITIES

This command draws a buffer zone of user specified size around any active map data set containing points, lines, or polygons which, if desired by the user, is then stored as a new active data map.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

BUFFER MAPID,SIZE,NAME

PARAMETERS

MAPID = Active Map ID Number
SIZE = Radius of buffer zone (miles)
NAME = Name of active map resulting from BUFFER, if this parameter is missing, the map is not stored

V. EXAMPLE

BUFFER 1,0.5,GROP

This command would draw a 0.5 mile buffer zone around the points, lines or polygons contained in active data map 1 and stores the results in a new active data map named GROP.

#49
COMPOSITE ARITHMETIC
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. COMPOSITE ARITHMETIC

III. NARRATIVE SUMMARY OF CAPABILITIES

This command arithmetically composites up to N maps (N = (Number of columns per map * Number of maps)/1000). Allowable functions are addition, subtraction, multiplication and division. The user may assign weights and output symbology. The resulting map is stored in the user work file.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

COMPOSITE MAPID1...MAPIDN,ARITHMETIC,OUTFIL

PARAMETERS

MAPID1...MAPIDN	=	Maps to arithmetically composite
ARITHMETIC	=	Tells MOSS to do arithmetic compositing
OUTFIL	=	Name to call saved work file
WT1,WT2,...WTN	=	Multiplicative weight which is coefficient of each map

The user is then prompted for the arithmetic expression and weights which have the following form:

NEW = WT1*MAPID1+WT2*MAPID2-WT3*MAPID3/WT4*MAPID4

Arithmetic precedence is from left to right.

V. EXAMPLE

COMPOSITE 6,7,3,2,ARITHMETIC,NEWMAP
NEWMAP = 2*Map6+.05*Map7-10.0*Map3-1*Map2

This command arithmetically composites maps 6,7,3, and 2 and stores the result in NEWMAP.

#50
COMPOSITE-LOGICAL
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. COMPOSITE (LOGICAL)

III. NARRATIVE SUMMARY OF CAPABILITIES

This command will utilize BOOLEAN logic to combine up to N active cell maps, where N can range up to (1000/NC) maps where NC equals the number of columns per map, and produce one output map. BOOLEAN logical operators of "EQ", "GT", "LT", or "NE" can be used with logical connectors of "AND" or "OR". A non-recursive approach is used for logical evaluation.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

```
COMPOSITE  MAPID1,MAPID2,...MAPIDN,TYPE,NCRIT,MAPOUT

           MAP NAME, OP1, VALUE, CON
           MAP NAME, OP2, VALUE, CON
           .
Criteria 1 .
           .
           END, REPLACEMENT VALUE

           MAP NAME, OP1, VALUE, CON
           MAP NAME, OP2, VALUE, CON
           .
Criteria 2 .
           .
           END, REPLACEMENT VALUE
```

PARAMETERS

MAPID1	=	Active Map ID Number
TYPE	=	Logical or arithmetic compositing See COMPOSITE-ARITHMETIC command
NCRIT	=	Number of logical criteria involved
MAPOUT	=	Name of output cell map
MAPNAME	=	Name of an active cell map
OP1	=	Logical operator for any test including the following: LE = Less than or equal EQ = Equals GT = Greater than LT = Less than NE = Not equals GE = Greater than or equal
VALUE	=	Integer value which is the object of comparison of a test

CON = Logical connector between tests of a criteria
Allowable values include the following:
"AND"
"OR"
DEFAULT ="OR"

END = "END" symbolizing the end of all tests within the criteria

REPLACEMENT VALUE = The actual value placed in the cell if the previous criteria has been satisfied

V. EXAMPLE

```
LOGICAL 1,3,7,8,2,COMP

           {WANCRT.EQ.1,AND
Criteria 1 {WVEGET.NE.2
           {END,8

           {ROADS.EQ.3
Criteria 2 {STREAMS.EQ.6
           {END,2

            END
```

These statements logically composite four maps (Active Cell Maps 1,3,7,and 8) using two logical criteria. The resulting map is called COMP. The criteria 1 states that if WANCRT equals a 1 and WVEGET is not equal to 2, the value in COMP is set to an 8.

#51
SLOPE
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. SLOPE

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to transform a cell matrix elevation map into relative slopes. The slope intervals can be determined by the user.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

SLOPE,MAPID, INTERVALS

PARAMETERS

MAPID = An Active Cellular Map Data Set which contains elevations
INTERVALS = The number of user specified intervals

V. EXAMPLE

SLOPE 2,3

This command transforms cell matrix elevation (Active Map ID 2) into a slope map of three intervals. The system prompts the user for minimum and maximum slope ranges within the three intervals.

I. SUBSYSTEM ANALYSIS

II. ASPECT

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to transform a cell matrix elevation map into relative aspects. The aspects plotted in cell format are N, NE, E, SE, S, SW, W, N.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

ASPECT MAPID

PARAMETERS

MAPID = A cell matrix elevation map

V. EXAMPLE

ASPECT 2

This command transforms cell matrix elevation map (Active 2) into an aspect map.

#53
GRID
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. GRID

III. NARRATIVE SUMMARY OF CAPABILITIES

This command performs point to grid interpolation. An irregular lattice of (X,Y,Z) triples is interpolated to an (X,Y) regular matrix in which each (X,Y) element contains an interpolated Z value. These regular grids are required for the following: 1.) Viewshed analysis, 2.) contouring, 3.) 3-D display, 4.) slope/aspect analysis, and 5.) any terrain modeling. The result is saved as a user named cell workfile.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

GRID MAPID MAXR MAXC MINZ MAXZ MAPOUT)

PARAMETERS

MAPID = Active Map Data Set to which will be gridded
MAXR = Number of cells in Y
MAXC = Number of cells in X
MINZ = Minimum interpolated value (default = 0)
MAXZ = Maximum interpolated value (default = AMAXZ)
MAPOUT= MAPOUTPUT Name for the resulting cellular file

V. EXAMPLE

GRID 2 30 50 0 40 ,RALPH

GRID active map data set 2. There are to be 30 rows,50 columns. MINZ=0 and MAXZ = 40. The name of the new map will be RALPH.

#54
TESTGRID
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. TESTGRID

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to draw a grid superimposed on a map display. The grid size is specified by the user in acres. The primary use for this command is for determining a good cell size for polygon to cell conversion and subsequent cell analysis.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

TESTGRID MAPID,CELLSIZE

PARAMETERS

MAPID = Active Map ID Number to be converted from polygon to cell
CELLSIZE = Acres per cell

V. EXAMPLE

TESTGRID 2,500

This command will superimpose a 500 acre grid over Active Map ID 2.

#55
QUERY
COMMAND SUMMARY

I. SUBSYSTEM ANALYSIS

II. QUERY

III. NARRATIVE SUMMARY OF CAPABILITIES

This command allows the user to point at a point, line,or polygon currently displayed on the CRT with the cursor. The command will print out the subject, description, category, item, and area or length of the item or nested items pointed at.

IV. COMMAND OPTIONS/PROMPTS

FORMAT

QUERY

PARAMETERS

None

V. EXAMPLE

QUERY

III. DATA STRUCTURE OF THE GIS

The following data structures are being used by the WELUT-02 GIS. This structure is also upward compatible with the more sophisticated WILCOTT DBMS.

III.

A. Cellular Master File Structure

This working paper describes the logical data structure for storing cell data in the Geographic Information System Data Base Management System.

The basic structure is a header followed by the cell data. There is one variation on this basic structure which is for handling the special case of long, thin study areas (known in some systems as the OUTLINE capability). In this case the basic structure is a header followed by an outline pointer table which is then followed by the cell data.

For the typical cell file, the detailed structure is:

User Specified 12/10/77		Header Length	1 integer (fixed)
		Users Name	20 characters (fixed)
		The Date of Creation	8 characters (fixed)
		Study Area Name	10 characters (fixed)
		Description	60 characters (fixed)
	*	Type rectangular irregular	1 integer (fixed)
System Calculated		Composed/no compr.	1 = not compressed (1 ID/word) 0 = compressed (10 ID's/word) 1 integer (fixed)
		# of rows in map	100 = recoded 000 = not recoded
		# of columns in map	1 word character string (fixed)
		cell size	1 word integer (fixed)
		X conversion cells/unit	1 word integer (fixed)
		Y conversion cells/unit	1 word integer (fixed)
	*	Projection UTM - 13 LAT, LONG	10 characters (fixed)
	*	Accuracy linear # of cells	1 word integer (fixed)

Purity Accuracy (polygon)	1 word integer (fixed)
Map Window (data base units)	4 words integer (fixed)
# entries in ID table	1 word integer (fixed)

User & System Generated

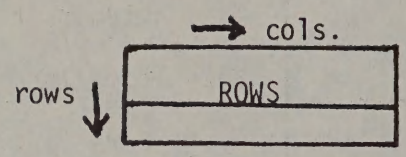
ID table → (A)

Int. code	ID descriptor	frequency

# of entries *2 variable length

1 word (integer)
+ 30 characters
+ 1 word (integer)

DATA



* In the special case of outline cell maps, there is another set of information that is stored at point A. This information contains 1) indentation (in cells) from left side of study area window to border of study area, 2) space (in cells) from the right border of the study area to the right border of the study area window, and 3) a pointer to the actual cell data in the data base. The actual structure of this information is dependent on the word size of the machine but would look something like:

ROW 1	*	LEFT INDENTATION	RIGHT SPACE	POINTER
ROW 2	*	INDENTATION	SPACE	POINTER

III.

B. Polygon/Arc/Point Text Master File Structure

This working paper describes the logical data structure for storing digitized (point, network, arc, or polygon) data in the Geographic Information System.

The basic structure is a user specified header followed by system generated data, followed by the data itself. The header and system generated sections will be produced by the Data General Eclipse EDIT routines (specifically the POST EDIT command). However, the CDC data manipulation, analysis, and display routines will not utilize a header. This header will be added during CDC to DG conversion.

USER SPECIFIED HEADER		Header Length	10 characters (fixed)
		Digitizer Name	20 characters (fixed)
		Date of Creation	10 characters (fixed)
		Digitizer Table Name	20 characters (fixed)
	*	Study Area Name	10 characters (fixed)
		Description	80 characters (fixed)
	*	Map Subject	10 characters (fixed)
		Map Title	80 characters (fixed)
	*	Map Source	10 characters (fixed)
	*	Data Type	6 characters (fixed)
		Lat/Long Box Southwest Cor, Northeast Cor	40 characters (fixed)
	*	UTM Box Southwest Cor, Northeast Cor	32 characters (fixed)
	*	UTM Zone	2 characters (fixed)
		Minimum Bounding Political Unit	30 characters (fixed)
	*	Map Scale 1:20,000,000	10 characters (fixed)

Data Type = Point, Arc_{nnn}, $Poly_{nn}$, Network

		Map Projection	10 characters (fixed)
	*	Map Vintage (date) Year	4 characters (fixed)
		Free Form Descriptor	80 characters (fixed)

		Positional Error with units	10 characters (fixed)
SYSTEM GENERATED		* Number of items	1 word integer
		* Pointer to Data	

DATA SECTION	1	Link to next record	physical address 1 word (int.)
	2	Length of record	1 word (integer)
	3	Subject - descriptor	3 words
	4	Category (from Boulder)	1 word
	5	Item (from Boulder)	1 word (integer)
	6	Number of descriptive words	1 word (integer)
	7	Type	1 word (integer)
Repeating group of record	8	Poly Area, or line length, arc length, point = null	1 word (integer)
	9	Polygon centroid	2 words (integer)
	10	Minimum Bounding Rectangle Xmin, Ymin, Xmax, Ymax	4 words (integer)
	11	If arc 5 words for center + left + right + attributes + polygon links	5 words - arc/network only (integer)
	12	EDIT FLAGS / POINTER TO TABLE	2 words (integer)
	13	Number of N Coordinate Pairs	1 word (integer)
	14	(If digital)Coord.string 1 coord. pair/word UTM.N, UTM.E, clockwise order (If text) characters FLAG word	N through X words (packed integer)
	15	(If digital)Coord.string 1 coord. pair/word UTM.N, UTM.E counter-clockwise order (If text) characters	X words (packed integer)
		next record link	

type: 1 = point
2 = network
3 = polygon
4 = arc
5 = text

data length: if polygon = # of coordinate pairs for polygon and holes
if point = 1
if text = # of characters of text
if arc, line = # of coordinate pairs for arc

IV. PROGRAMMING STANDARDS FOR THE GIS

The following programming standards will be adhered to for the FRMS-WELUT-02 project.

A. ANSI Fortran Subset Used

The following ANSI-Fortran IV Subset (see Appendix A) is compatible with the CDC-CYBER, UNIVAC 1108, DATA GENERAL ECLIPSE, INTERDATA 8/32, and all other third generation hardware. Only these commands will be used except in system dependent routines where they will be isolated and fully documented.

By utilizing only ANSI-Fortran statements and by observing the strict programming conventions set out in Section IV-A and the internal documentation standards set out in Section IV-B, this set of GIS software should be highly machine independent.

B. Programming Conventions Used

General Subroutine or Program Format

1) The program, subroutine, or function name is the first statement.

2) The program, subroutine, or function name is immediately followed by the declarative statements.

3) Declarative statements are followed by a comment block*

4) Code follows comments and should:

   a) have some structure (indentation of major segments of code within "do loops" etc.)
   b) try to have statement labels in sequence
   c) try to use a different order of statement label for FORMATS (i.e. statement labels might range from 1-100 and FORMATS statements from 1000-2000)
   d) judicious use of in line commenting*

General Programming Rules

1) Try to follow ANSI standards**

2) Thou shalt not use:

   a) IMPLICIT INTEGER
   b) GO TO'S that jump back up to previously executed code without good reason (the flow should always be down)
   c) ENTRY POINTS within a routine
   d) Unlabeled COMMON
   e) Machine dependent features or functions unless absolutely necessary. When machine dependent features are used, they should be isolated in one routine and well documented.
   f) Variable names longer than six characters
   g) Alpha fields greater than A2 in system independent routines
   h) R FORMAT (Right Justified Character String) in system independent routines

3) Thou shall try to:

   a) Keep routines short (100 lines or less of executable code)
   b) Use variable names that mean something in logic of program
   c) Use parameter sets in subroutine and function calls instead of common, especially in lower level routines
   d) Generate efficient code
   e) Be consistent from one routine to the next

4) All machine dependencies should be isolated in as few as possible lower level I/O, or character manipulation routines. These machine dependent routines should be documented thoroughly.
5) All matrices and variables which are not in an input list should be initialized at the beginning of a program
6) All user input commands shall have the option of complete prompting with defaults (for novice users) or user specified parameters in a single command string (for experienced users)
7) A uniform set of LABELED COMMON blocks shall be placed in all routines using any LABELED COMMON
8) Debug statements should be written into and maintained in the code so they can be switched on or off by the systems programmer
9) CODE should be as straight forward as possible realizing that the developer may not be the system maintainer

* See "Internal Documentation Standards" Task 2130 results
** See "ANSI FORTRAN SUBSET" Task 2110 results (Appendix A)

IV.

C. Internal Documentation Standards Used

The following rules for in-code documentation are suggested:

1. A comment block at the beginning of the program, subroutine, or function that contains the following information:

   a. FUNCTION of routine
   b. INPUT parameters
   c. OUTPUT from routine
   d. NAME of programmer
   e. DATE of this version
   f. AFFILIATION of programmer
   g. CITATIONS if code obtained from elsewhere and modified
   h. MACHINE DEPENDENCIES
   i. SUBROUTINES REQUIRED
   j. ALGORITHMS, if any are used

2. Comment cards scattered through code as required to:

   a. explain what a section of code performs, such as some mathematical computation or extraction of data from the data base.

   b. explain changes in pointers and indices.

   c. explain subroutine calls and call parameters

   d. separate discrete units of code

   e. other comments that will tell the reader what is going on. Use your own judgement.